Claims

[c1] What is claimed is:

1.A high frequency induction heater built in an injection mold comprising:

at least a stamper, fabricated by micro electromechanical system (MEMS)technologies, having a micro pattern of a micro system;

at least a high frequency induction heating module, fabricated by MEMS technologies, positioned on a side of the stamper, the high frequency induction heating module comprising at least a set of high frequency induction heating coils, the high frequency induction heating module being controlled by a driver positioned outside the injection mold; and

at least a set of thermometer detectors, fabricated by MEMS technologies, positioned between the set of high frequency induction heating coils, the set of thermometer detectors being controlled by a temperature controller positioned outside the injection mold;

wherein the high frequency induction heating module emits electromagnetic waves which penetrate the stamper and applies a local heat to a plastic such that sections of the plastic having a thin thickness or sections

having a large difference of cross sectional areas remains fluid, in such case the micro pattern of the micro system is accurately transferred to the plastic by injection compression molding technologies.

[c2] 2.The high frequency induction heater of claim 1 wherein the MEMS technologies comprise the following steps:
(a)depositing an oxide layer or a nitride layer onto a metal substrate as an insulating layer;
(b)depositing a platinum layer, and performing a photo-etching process which includes coating a photoresist pattern, exposing, developing, and etching, for defining a thermometer detector pattern;
(c)depositing an oxide layer or a nitride layer as an insulating layer to cover the thermometer detector pattern;
(d)coating a thick photoresist pattern with high solidification strength, performing an exposure process and a development process, electroforming a copper layer to a desirable height, and performing a chemical mechanical polishing (CMP) process to planarize the copper layer for forming the set of high frequency induction heating coils;
(e)coating a thick photoresist pattern with high solidification strength, performing an exposure process and a development process, electroforming a copper layer to a desirable height, and performing a CMP process to pla-

narize the copper layer for forming via holes;
(f)coating a thick photoresist pattern with high solidification strength, performing an exposure process and a development process, electroforming a copper layer to a desirable height, and performing a CMP process to planarize the copper layer for forming an external power circuit; and
(g)polishing the metal substrate.

[c3] 3.The high frequency induction heater of claim 1 wherein a microstructure is inserted into the stamper by MEMS electroforming technologies, and the high frequency induction heater positioned under the microstructure or the stamper is capable of applying the local heat and controlling an overall temperature so that the plastic is fluid and a deformation due to a temperature difference is prevented.

[c4] 4.The high frequency induction heater of claim 3 wherein a material of the microstructure is a metal identical to that of the stamper or a metal differing from that of the stamper, the material identical to that of the stamper is for controlling the overall temperature, the metal differing from that of the stamper is for applying the local heat, if the material of the microstructure differs from that of the stamper, the microstructure then has a higher magnetic permeability or a higher induction heating

ability than the stamper.

[c5] 5.The high frequency induction heater of claim 1 wherein the stamper and the high frequency induction heater are fabricated individually or jointly, and if the stamper and the high frequency induction heater are fabricated jointly, then step (g) of claim 2 is replaced by the following steps:
turning the metal substrate over;
performing a photo-etching process to etch the metal substrate;
performing an electroforming process to form a magnetic layer comprising iron and nickel for forming a microstructure; and
performing a CMP process to planarize the magnetic layer for forming an insert mold having a built-in high frequency induction heater.

[c6] 6.The high frequency induction heater of claim 1 wherein the set of high frequency induction heating coils are positioned under a surface of the high frequency induction heater, thus a multi-level interconnect technology is adopted to locate the external power circuit in a bottom layer, and only a microstructure of the set of high frequency induction heating coils is exposed in an upper layer.

[c7] 7.The high frequency induction heater of claim 1 being capable of being positioned in a stationary mold-half and/or in a movable mold-half.

[c8] 8.The high frequency induction heater of claim 1 wherein the high frequency induction heater and the thermometer detectors are controlled by a plurality of drivers and temperature controllers operating individually.

[c9] 9.The high frequency induction heater of claim 1 being capable of fabricating wafer-level plastic discs (6 inches to 8 inches) by injection compression molding technologies, and further performing a wafer-level package process on a substrate having ICs or MEMS elements.

[c10] 10.A method of forming a wafer-level three dimensional (3D) micro component comprising:
fabricating two stampers by MEMS technologies, each stamper having a micro pattern, the two micro patterns forming a cavity;
positioning one of the stampers in a stationary mold-half of an injection mold, and placing the other stamper in a movable mold-half of the injection mold;
positioning at least a high frequency induction heating module fabricated by MEMS technologies on a side of the stamper, the high frequency induction heating module comprising at least a set of high frequency induction

heating coils, the high frequency induction heating module being controlled by a driver positioned outside the injection mold; and

positioning at least a set of thermometer detectors fabricated by MEMS technologies between the set of high frequency induction heating coils, the set of thermometer detectors being controlled by a temperature controller positioned outside the injection mold;

wherein the high frequency induction heating module emits electromagnetic waves which penetrate the stamper and apply a local heat to a plastic such that sections of the plastic having a thin thickness or sections having a large difference of cross sectional areas remains fluid and well filled, in such case the micro pattern of the 3D micro component is accurately transferred to the plastic by injection compression molding technologies.

[c11] 11.The method of claim 10 wherein the MEMS technologies comprise following steps:

(a)depositing an oxide layer or a nitride layer onto a metal substrate as an insulating layer;

(b)depositing a platinum layer by photo-etching technologies, which includes coating a photoresist layer, exposing, developing, and etching, for defining a thermometer detector pattern;

(c)depositing an oxide layer or a nitride layer as an insu-

lating layer to cover the thermometer detector pattern;
(d)coating a thick photoresist layer with high solidification strength, performing an exposure process and a development process, electroforming a copper layer to a desirable height, and performing a chemical mechanical polishing (CMP) process to planarize the copper layer for forming induction coils;
(e)coating a thick photoresist layer with high solidification strength, performing an exposure process and a development process, electroforming a copper layer to a desirable height, and performing a CMP process to planarize the copper layer for forming via holes;
(f)coating a thick photoresist layer with high solidification strength, performing an exposure process and a development process, electroforming a copper layer to a desirable height, and performing a CMP process to planarize the copper layer for forming an external power circuit; and
(g)polishing the metal substrate.

[c12] 12.The method of claim 10 wherein a microstructure is inserted into the stamper by MEMS electroforming technologies, and the high frequency induction heating module positioned under the microstructure or the stamper is capable of applying the local heat and controlling an overall temperature so that the plastic is fluid and a de-

formation due to a temperature difference is prevented.

[c13] 13.The method of claim 12 wherein a material of the microstructure is a metal identical to that of the stamper or a metal differing from that of the stamper, the material identical to that of the stamper is for controlling the overall temperature, the metal differing from that of the stamper is for applying the local heat, if the material of the microstructure differs from that of the stamper, the microstructure then has a higher magnetic permeability or a higher induction heating ability than the stamper.

[c14] 14.The method of claim 10 wherein the set of high frequency induction heating coils are positioned under a surface of the high frequency induction heating module, thus a multi-level interconnect technology is adopted to position the external power circuit in a bottom layer, and only a microstructure of the set of high frequency induction heating coils is exposed in an upper layer.

[c15] 15.The method of claim 10 wherein the high frequency induction heating module is capable of being positioned in the stationary mold-half and/or in the movable mold-half.

[c16] The method of claim 1 0wherein the high frequency induction heating module and the thermometer detectors

are controlled by a plurality of drivers and temperature controllers operating individually.